

What Do Exposure and Dosimetry Studies Tell Us about the Respiratory Dose to Susceptible Populations?

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Keywords: particulate matter, dosimetry, deposition efficiency, asthmatic persons, chronic obstructive pulmonary disease

Particulate matter (PM) in the air is known to cause adverse health effects, particularly in elderly subjects with respiratory and cardiopulmonary disease. Although observed health effects are likely caused by multiple factors, the respiratory dose is one factor of particular concern because the morphological and physiological changes of the lung can alter deposition characteristics of inhaled particles. Respiratory dose is determined by two factors: exposure conditions (external) and deposition efficiency in the lung (internal). Scientists in the National Health and Environmental Effects Research Laboratory (NHEERL) and National Exposure Research Laboratory (NERL) have been investigating these two issues, and our poster presents some significant findings from a few recent studies.

Elderly subjects, particularly those who are in poor health, are thought to have less exposure to PM because they stay mostly indoors. In recent Seattle studies, however, comparing personal PM_{2.5} exposure among four different cohorts - healthy elderly subjects, elderly with coronary heart disease, elderly with chronic obstructive pulmonary disease (COPD), and children with asthma - the personal exposure was similar for the healthy elderly and two sick elderly cohorts. Personal exposure was somewhat greater for children because they stay longer outdoors. Thus, exposure per se may not be a contributing factor for adverse health effects observed in elderly patients.

In dosimetry studies performed in HSD laboratory, lung deposition efficiency of different size particles including ultrafine, fine, and coarse particles was measured in healthy elderly subjects, and the results were compared with those obtained in young adults. There was no difference between the two groups for all particles tested, indicating that age is not a contributing factor for lung deposition. Total lung deposition dose in subjects with asthma and COPD, however, was found to be greater than in healthy subjects under the same exposure conditions. Furthermore, deposition patterns in the lung were not the same: deposition was greater in the proximal bronchial airways but was the same or lower in deep lung regions in patient groups compared with healthy subjects, particularly for coarse particles. Deposition distribution in the lung was found to be very uneven in subjects with COPD, showing marked enhancement in local airway regions. This uneven deposition pattern would result in excessive doses at local airway sites even under the seemingly usual exposure conditions, and could play a crucial role in initiating the events leading to tissue injury and other adverse effects. Thus, assessment of individual variability in exposure and internal dose among different subject groups will help to better identify the risk factors associated with PM and other potentially harmful substances.

***Notice:** This abstract does not necessarily reflect EPA policy.*

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